REVIEW REQUESTED BY

THE DEPARTMENT OF JUSTICE

OF

THE ACOUSTICAL REPORTS PUBLISHED BY

THE HOUSE SELECT COMMITTEE ON ASSASSINATIONS

Review Prepared By The Technical Services Division
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TABLE OF CONTENTS

Abbreviations Used In Review PAGE 1

Section I. The Findings of the Federal Bureau of Investigation's Review of the Acoustical Reports Published by the House Select Committee On Assassinations PAGE 2

Section II. Summary of Bolt Beranek and Newman, Inc., Report Entitled "Analysis of Recorded Sounds Relating To The Assassination of President John F. Kennedy," Dated January, 1979 PAGES 3 - 6

Section III. Summary of Mr. Mark R. Weiss and Mr. Ernest Aschkenasy's Report Entitled "An Analysis Of Recorded Sounds Relating To The Assassination of President John F. Kennedy," Dated February, 1979 PAGES 7 - 12

Section IV. Federal Bureau of Investigation's Critique of the Findings of the Acoustical Analyses Performed by Bolt Beranek and Newman, Inc., Mark R. Weiss and Ernest Aschkenasy PAGES 13 - 20

Section V. Reply to Department of Justice Requests of November 8, 1979 PAGES 21 - 22

ABBREVIATIONS USED IN REVIEW

BBN	Bolt Beranek and Newman, Inc.
The Committee	The House Select Committee on Assassinations
dB	Decibels
DPD	Dallas Police Department
ft	Feet
mph	Miles Per Hour
sec	Seconds
TSBD	Texas School Book Depository

I. THE FINDINGS OF THE FEDERAL BUREAU OF INVESTIGATION'S REVIEW OF THE ACOUSTICAL REPORTS PUBLISHED BY THE HOUSE SELECT COMMITTEE ON ASSASSINATIONS

1. The analyses of acoustical evidence by Bolt Beranek and Newman, Inc., Mark R. Weiss, and Ernest Aschkenasy did not scientifically prove that a gunshot was fired by a second gunman from the grassy knoll area of Dealey Plaza during the assassination of President Kennedy on November 22, 1963. Therefore, the House Select Committee on Assassination's finding that "scientific acoustical evidence establishes a high probability that two gunmen fired at President John F. Kennedy" is invalid.

2. The analyses of acoustical evidence by Bolt Beranek and Newman, Inc., Mark R. Weiss, and Ernest Aschkenasy did not scientifically prove that the Dictabelt recording of Channel 1 of the Dallas Police Department radio system contains the sounds of gunshots or any other sounds originating in Dealey Plaza during the assassination of President Kennedy on November 22, 1963.

II. SUMMARY OF BOLT BERANEK AND NEWMAN, INC., REPORT ENTITLED "ANALYSIS OF RECORDED SOUNDS RELATING TO THE ASSASSINATION OF PRESIDENT JOHN F. KENNEDY," DATED JANUARY 1979

In May, 1978, the House Select Committee on Assassinations (the Committee) asked Bolt Beranek and Newman, Incorporated, (BBN) to conduct an examination of several items of evidence involved in the assassination of President John Fitzgerald Kennedy in Dealey Plaza, Dallas, Texas, on November 22, 1963. One of the items of evidence was a recording made on a Dictabelt recorder which had continuously recorded Dallas Police Department (DPD) radio traffic on channel 1 directly before, during, and after the assassination of President Kennedy. During the assassination the radio of a DPD motorcycle, that may have been in the Presidential motorcade, was thought to have been stuck in the transmitting mode for approximately five minutes. BBN was asked to analyze the recording to determine if it contained the sounds of gunfire, and if so, how many gunshots were recorded by the DPD Dictabelt recorder and from what locations did the gunshots originate.

7 BBN used a bandpass and a digital adaptive filter to process the DPD channel 1 recording during the specified five minutes, and then displayed this enhanced signal in the form of a time-continuous waveform. This waveform displayed five impulsive noise patterns thought to be different from motorcycle sounds, according to BBN, and then the report reflects that four of these patterns appeared to be "similar to the expected characteristics of a shock wave and of a muzzle blast" of a discharged weapon. The other pattern was eliminated as a possible gunshot, according to the report, since it "was sufficiently different in amplitude and duration as to have been caused by a different source."

The BBN report states that a discharge from a rifle firing a supersonic bullet creates two sources of impulsive sound - the muzzle blast and the shock wave of the projectile as it travels faster than the speed of sound. These two sounds plus the proceeding echoes of these sounds reflecting and diffracting off surfaces, such as the sides of buildings, the ground, and automobiles, result in a particular echo pattern of sound impulses.

If a gunshot had been sensed by a DPD motorcycle microphone then "all sound impulses arriving at the [DPD motorcycle] microphone that are loud enough to be heard over the environmental noise would be transmitted over the radio connected to the microphone. In this case, the environmental noise consisted primarily of the very loud, repetitive noise made by the engine of a moving motorcycle..."

"The loudest sound impulses from gunfire are considerably louder than the loudness of speech, for which the [DPD] radio was designed to operate. These loud impulses overdrive the radio circuitry. Because of the limiting circuits in the radio transmitter, very loud sounds are recorded in distorted fashion and appear as much weaker signals than they really are..."

"After the sounds that are picked up at the microphone had been transmitted to the DPD radio receiver, the output of the receiver was recorded on a Dictabelt recorder. The circuitry of the receiver and the characteristics of the recorder also affected the transmitted signals. The recorded loudness of the sounds transmitted from the motorcycle radio with the stuck microphone were additionally affected somewhat by simultaneous transmissions from other officers in the motorcade. An FM radio receiver, such as the one in DPD headquarters, receives best from the transmitting radio having the strongest transmitted signal..."

"Thus, the effects of severe environmental noise, of the limiting circuitry of the radio transmitter, of simultaneous radio transmissions, and of the recording characteristics of a Dictabelt recorder were such that any waveforms that would emerge from an analysis of the tape would be severely distorted."

Tests performed by BBN on a radio system similar to that used by the DPD and depicted in Figure 10 of the BBN report showed considerable distortion of loud impulsive sounds, such as gunshots, which resulted in elimination of impulse peaks, changing the position of peaks, and even producing new peaks where no impulse peaks previously existed.

Preliminary tests by BBN determined that the four chosen impulse patterns occurred at approximately the same time as the known gunshots in Dealey Plaza, that no other sufficiently characteristic patterns were located in the pertinent five-minute segment, that the time span between the first and fourth patterns did not contradict photographic evidence concerning the timing of the first and last gunshots, that the distorted patterns approximated test patterns of gunshots, and that the amplitudes of the impulse patterns were in the same range as test gunshots.

On August 20, 1978, BBN fired a total of 12 test gunshots with weapons located only in the Texas School Book Depository (TSBD) and on the grassy knoll area in Dealey Plaza. Using 36 microphones located 18 feet apart on Houston and Elm Streets in Dealey Plaza, BBN recorded these test gunshot blasts in an effort to reconstruct acoustically the impulse patterns recorded by the DPD radio system during the assassination of President Kennedy. Even though few physical changes had been made in Dealey Plaza since 1963, producing comparable test patterns was very difficult since the impulse patterns on the DPD recording were like "badly smudged 'fingerprints'," due to the noisy environment in the vicinity of the transmitting DPD radio microphone, the poor quality of the DPD recording system, and a number of other problems.

Using the 12 different test gunshots from the TSBD and the grassy knoll and the 36 different microphone locations used by BBN, a total of 432 gunshot patterns were recorded (12x36=432). These 432 test gunshot patterns were then compared to the impulse patterns isolated on the channel 1 DPD recording using the statistical analysis technique of binary correlation. "The binary correlation coefficient of two sequences is a number that is exactly 1.0 if the sequences are identical and that rapidly approaches zero as they grow more dissimilar." This comparison provided a total of 15 matches with a correlation coefficient equal to or exceeding 0.6; however, the expected average number of false matches for such a comparison was 13, due to random noise impulses present throughout the DPD tape.

BBN then stated that at least six of the 15 correlations were false matches, because one gunshot would have been fired at the wrong target, one would have occurred only 1.05 seconds after earlier correlations which is too fast a firing rate for the tested rifle, three would have required a motorcycle with the open microphone to travel at 16 mph, and one would have required the motorcycle to travel at 55 mph. The motorcade was thought to have been traveling at approximately 11 mph. The remaining nine correlations sufficiently matched the four designated impulse patterns on the DPD recording to show a DPD microphone location varying between 120 and 160 feet behind the Presidential limousine. Further, the BBN analysis found that the four impulse patterns may have been gunshots fired as follows:

"1. time 0.0 sec - one shot from the [TSBD] . . . "

"2. time 1.6 sec - one shot from the TSBD . . . "

"3. time 7.8 sec - one shot from behind the fence on the knoll . . . "

"4. time 8.3 sec - one shot from the TSBD . . . "

The BBN conclusions were presented in oral testimony to the Committee on September 11, 1978, reflecting that the radio on a DPD motorcycle in the Presidential motorcade had received and transmitted the four specified impulse sounds, and that each of these impulse sounds was possibly a gunshot. Due to the false matches produced by the binary correlation detector at a "50%" rate per match, the probabilities, according to BBN, that a gunshot occurred at the four times are:

"Shot 1. 88% based on three matches
Shot 2. 88% based on three matches
Shot 3. 50% based on one match
Shot 4. 75% based on two matches."

BBN stated that the probability that all four gunshots occurred is only 29%.

The final findings of the BBN analysis, which also includes a review of the work of Weiss and Aschkenasy (summarized in Section III) are:

1. The impulse patterns on channel 1 of the DPD radio system recording probably include the sounds of four gunshots fired in Dealey Plaza on November 22, 1963.

2. The impulse patterns were received and transmitted by a radio mounted on a DPD motorcycle in the Presidential motorcade and the motorcycle was located from 120 to 160 feet behind the Presidential limousine.

3. "The first probable shot was fired at about 12:30:47 from the TSBD . . . [but] no conclusion can be drawn about whether this first acoustic disturbance was due to a rifle or to a sound impulse as loud as the report of a rifle . . ."

4. "The second probable shot was fired about 1.6 sec after the first one, also from the TSBD . . ."

5. "The third probable shot was fired about 7.6 sec after the first one, and it was fired from behind the fence upon the 'grassy knoll' . . . [and] the third shot is probably from a rifle."

6. "The fourth probable shot was fired about 8.3 sec after the first one, and it was fired from the TSBD . . . [and] the fourth shot is probably from a rifle."

7. "Additional police radio transmissions are intermittently recorded on the tape during and after the last two probable shots. These transmissions contribute a few electrical impulses to the noise background in which the impulses of gunfire are set. However, these noise impulses are too few in number to have a material effect on the accuracy by which the echo patterns of the acoustical reconstruction match the impulse patterns on the DPD tape."

III. SUMMARY OF MR. MARK R. WEISS AND MR. ERNEST ASCHKENASY'S REPORT ENTITLED "AN ANALYSIS OF RECORDED SOUNDS RELATING TO THE ASSASSINATION OF PRESIDENT JOHN F. KENNEDY," DATED FEBRUARY 1979

On October 24, 1978, the Committee authorized Mark R. Weiss and Ernest Aschkenasy, Department of Computer Science, Queens College, City University of New York, to conduct an independent analysis of specified sounds recorded on channel 1 of the DPD radio system. The purpose of the analysis was to determine with greater accuracy whether certain sounds on the DPD recording were indicative of a gunshot from the grassy knoll in Dealey Plaza, Dallas, Texas, on November 22, 1963, during the assassination of President Kennedy. The BBN report (summarized in Section II) had reflected "that, with a probability of 50 percent, the recording contains sounds of a gunshot, or at least sounds as loud as a gunshot, fired from the so-called grassy knoll area of Dealey Plaza in Dallas; they were received by a microphone on a DPD motorcycle that was moving on Elm Street at a speed of about 11 mph in the same direction as the Presidential motorcade."

To conduct their analysis, Weiss and Aschkenasy received from the Committee high quality magnetic tape copies of the DPD recording, a high quality tape copy of the gunshot sounds recorded by BBN during the acoustical reconstruction tests performed in Dealey Plaza on August 20, 1978, a topographical survey map of Dealey Plaza (scale: 1 inch to 10 feet), a map of Dealey Plaza (scale: 1 inch to 40 feet) with microphone locations used by BBN in their gunshot reconstruction tests, and aerial and ground-level photographs of Dealey Plaza and the surrounding areas. The Committee also provided them with additional information "such as the heights of buildings in Dealey Plaza, the distance to objects not shown on the maps, the location of the DPD shooter during the BBN reconstruction experiment and the air temperature in Dealey Plaza at the time of the assassination and during the reconstruction experiment."

Weiss and Aschkenasy's report reflects that during the assassination of President Kennedy the radio of a DPD motorcycle, that may have been in the Presidential motorcade, was thought to have been stuck in the transmitting mode for approximately five minutes. During this five-minute interval, staticlike sounds that might be distorted gunshots were heard, including the impulse pattern that BBN had identified as having a 50% probability of being a gunshot or an equally loud sound in the area of the grassy knoll in Dealey Plaza. Weiss and Aschkenasy attempted to determine whether these staticlike sounds represented a gunshot sound and not another type of loud sound, whether the origin of these sounds could be more precisely located on the map, and whether a higher probability value could be computed.

Their report states that "the DPD recording [being examined] contains a wide range of sounds - speech, clicks, whistles, motor noises, sirens, and even the sound of a carillon bell. Mostly the recording contains sounds generated during normal communications on channel 1 of the DPD radio dispatching system . . . At the time that the BBN analysis estimates to have been about 12:28 p.m., a microphone on a mobile unit apparently became stuck in the 'on' position and began to transmit a continuous noise that is believed to be the sound of a motorcycle engine."

Weiss and Aschkenasy state that the staticlike sounds on the DPD recording could be distorted gunshot sounds, since the DPD radio system would have "...compress[ed] the peak amplitude of the sounds of the muzzle blast and of its strongest echoes, making them only slightly louder than those of some of the weaker echoes. Furthermore, if the microphone was on a DPD motorcycle in the motorcade, most of the many very weak echoes of the muzzle blast would have been obscured by the noise of the motorcycle engine (which is possibly the source of the continuous noise on the DPD recording). Consequently, the sounds of a gunshot would have been recorded as a sequence of very brief impulse sounds (the muzzle blast and its loudest echoes), only a few of which would have been larger than the accompanying engine noise, and none of which would have sounded to the ear like gunshots after being distorted by the limiting circuitry of the DPD radio and recording equipment."

The report states that the higher impulse sounds on the DPD recording could be generated by a number of sources including misfiring of a motorcycle engine, noise produced by the motorcycle's ignition system, radio on-and-off clicks, scratches on the Dictabelt and electrical or mechanical disturbances in the system. Weiss and Aschkenasy, in an effort to differentiate these sounds from a gunshot, stated that "the most effective and most reliable" characteristic to determine if a sound is a gunshot is the presence or absence of an array of echo-delay times of the muzzle blast. This array is produced since firing a gun produces a loud impulse sound about 5 milliseconds (5/1000 of a second) in length that spreads out in all directions. This sound is then reflected and diffracted off any structures in the area, producing echoes which arrive at the microphone later than the direct muzzle blast impulse. Weiss and Aschkenasy's report states that the specified impulse pattern on the DPD recording had this array of echo delay times, thus reflecting that it was a gunshot. However, in public testimony before the Committee on December 29, 1978, Weiss stated that it is "...not so much the echo pattern as the evidence of a [supersonic] shock wave" that would characterize a gunshot sound, and eliminate other sounds like the backfire of a motorcycle. Weiss further stated he "...cannot think of any [other sound] that might resemble..." the pattern he determined to be a gunshot due to the presence of the supersonic shock wave and the muzzle blast impulses.

Weiss and Aschkenasy state in their report "if we now assume that the sound source (the gun) and the listener are located in a typical urban environment, with a number of randomly spaced echo-producing structures, it is possible to see that the pattern of sounds a listener will hear will be complex and unique for any given pair of gun and listener locations. For example, assuming a fixed location of a listener, the echoes that he hears and the times at which he hears them will be related uniquely to the location of the gun, since for each different location of the gun, even though the distances from the listener to the various echo-producing objects are the same, the distances from these objects to each gun location are different. Consequently, the times at which the echoes are heard will be different for each location of the gun. Similarly, assuming a fixed location of the gun, any change in the location of the listener will change the distances between him and the echo-producing structures, and thus the timing of the pattern of sounds he hears. If the listener is in motion as the muzzle blast and the various echo sounds reach him, the times at which he hears the muzzle blast and its echoes will be related uniquely to his location when he hears each sound. . . The 'listener' that we have discussed, of course, could be either a human ear or a microphone. If a microphone receives the sounds and they are subsequently recorded, the recording becomes a picture of the event, not unlike a 'fingerprint,' that permanently characterizes the original gun and microphone locations."

Using the topographical map of Dealey Plaza and the BBN reconstruction results (test gunshots fired only from the TSBD and the grassy knoll), Weiss and Aschkenasy attempted to predict a pairing of a shooter and a microphone that would produce a sound pattern that would match the specified impulse pattern on the DPD recording. To calculate these predicted echo-delay sequences or patterns of a particular shooter and microphone location in Dealey Plaza, three pieces of information were needed: "(1) Which objects in Dealey Plaza would produce echoes in the region of interest on Elm Street for a gun fired from the vicinity of the grassy knoll[?]; (2) how far these objects were from the locations of the gun and of the microphone[?]; and (3) what was the speed of sound under the conditions for which the echo travel times were to be predicted[?]." First, a close examination of the topographical map revealed many of the reflecting and diffracting surfaces within Dealey Plaza. Second, direct measurement on the map determined the distances from the gun to the reflecting and diffracting surfaces and then to the microphone location. Third, the speed of sound was determined to be approximately 1,123 feet per second, principally by using the known air temperature near Dealey Plaza on November 22, 1963, of approximately 65 degrees Fahrenheit.

To make a comparison of predicted echo-delay patterns to the specified pattern on the DPD recording, the error in time accuracy of the DPD recording had to be determined. Weiss and Aschkenasy used a plus or minus 1.0% error for the speed of sound due to temperature variations (plus or minus 10 degrees Fahrenheit) and a minus 4.0% to minus 6.0% error for speed variations on the DPD Dictabelt recorder, since the average speed of the recorder over a 15-minute segment was 5.0% too slow. These two errors combined to give a maximum possible time error range of minus 3.0% to minus 7.0%. Weiss and Aschkenasy then state that since any value within this maximum error range is "...theoretically valid, it was permissible to choose the value between those limits that created the best match between the impulse and [predicted] echo sequences;" a minus 4.3% error factor "...gave the best match, and we therefore used that factor."

"After numerous comparisons between the echo-delay times for the sounds on the DPD recording and various predicted patterns for assumed motorcycle and shooter locations that did not match, a combination of motorcycle and shooter locations was found which mathematically produced a predicted pattern that showed strong similarities to the pattern of impulses on the DPD tape. However, to determine with a high level of certainty if these two sequences of echo-delay times, which were derived from different data, represented the same source, it was not enough to show that the sequences looked alike. They had to be shown to be alike in an objective sense, that is, by use of a method of comparison that disregarded potentially misleading appearances. Such a method [according to Weiss and Aschkenasy] was provided by a computation of the binary correlation coefficient of the two sequences. The binary correlation coefficient of two sequences is a number that is exactly 1.0 if the sequences are identical and that rapidly approaches zero as they grow more dissimilar. As used in this analysis, the binary correlation coefficient takes into account the number of echo-delay times in each of the sequences and the number of echoes that coincide. Echoes in the two sequences are said to coincide if their delay times differ by a small amount. The smaller this amount, or 'coincidence window,' can be made while maintaining a high binary correlation coefficient, the greater will be the probability that the DPD sequence represents a gunshot from the grassy knoll."

According to Weiss and Aschkenasy, the binary correlation coefficient is defined as the number of echoes that coincide between the predicted echoes and the specified sound impulses on the DPD recording using the coincidence window, divided by the square root of the product of the total number of predicted echoes and the total number of sound impulses.

Weiss and Aschkenasy then made two comparisons between the pattern of impulses, specified as possibly the third gunshot by BBN, and the most similar predicted echo pattern as computed on the topographical map for a particular shooter and microphone pair. The first comparison was between the DPD recorded impulses "...that were significantly louder than the average background noise [a total of 15] and those predicted echoes that would have been recorded with comparable loudness" (a total of 13). Eleven of the recorded impulses and predicted echoes matched (with "impulse peaks that [were] less than one millisecond apart considered to be part of the same impulse"), which produced a binary correlation coefficient of 0.79 (11 divided by the square root of [13 x 15]). "In the other comparison, the delay times of all the recorded sounds [18] and of all of the predicted echoes [12], up to a total delay of 50 milliseconds from the muzzle blast, were compared." Eleven of the echoes and impulses matched, which produced a binary correlation coefficient of 0.75 (11 divided by the square root of [12 x 18]).

"In both of the comparisons described above, the coincidence window was set at plus or minus 1 millisecond. That is, a measured echo-delay time and a predicted one were said to coincide only if they were no more than 1 millisecond apart. For sequences that correlated at levels greater than 0.7 with a coincidence window of plus or minus 1 millisecond, the statistical probability was 95 percent or more that the sequences represented the same source - a sound as loud as a gunshot from the grassy knoll. Put alternatively, the probability that the sounds on the DPD recording were generated by sources other than a sound as loud as a gunshot originating from the grassy knoll is 5 percent or less."

The findings of Weiss and Aschkenasy concerning the specific sounds on the DPD recording are:

> "1. The recording very probably contains the sound of a gunshot that was fired from the grassy knoll. The probability of this event is computed to be at least 95 percent.
>
> "2. The microphone that picked up the sounds of the probable gunshot was on Elm Street and was moving at a speed of about 11 miles per hour in the same direction as the motorcade. At the time the probable gunshot was fired, the microphone was at a point about 97 feet south of the TSBD and about 27 feet east of the southwest corner of the building. (For both distances, the uncertainty is about plus or minus 1 foot).

> "3. The probable gunshot was fired from a point along the east - west line of the wooden stockade fence on the grassy knoll, about 8 feet (plus or minus 5 feet) west of the corner of the fence."

In testimony in a public hearing before the Committee on December 29, 1978, Weiss listed two additional findings that were not in his report of February, 1979, as follows:

> 1. The specified pattern found to be a gunshot from the grassy knoll was most likely supersonic, and probably fired by a rifle. However, Weiss and Aschkenasy stated in their report that no analysis was made "...of the type of weapon fired."
>
> 2. The weapon fired on the grassy knoll "...would have been fired in a general direction of [President Kennedy's Limousine]."

Aschkenasy stated at the public hearing on December 29, 1978, that he was so sure of their results that "...if someone were to tell me that the motorcycle was not in Dealey Plaza, and he was, in fact, somewhere else, and he was transmitting from another location...I would ask to be told where that location is, and once told where it is, I would go there, and one thing I would expect to find is a replica of Dealey Plaza at that location. That's the only way that it can come out."

IV. FEDERAL BUREAU OF INVESTIGATION'S CRITIQUE OF THE FINDINGS OF THE ACOUSTICAL ANALYSES PERFORMED BY BOLT BERANEK AND NEWMAN, INC., MARK R. WEISS AND ERNEST ASCHKENASY

A review of the written findings and oral testimony of BBN, Weiss and Aschkenasy reflects that the following two basic, underlying premises must both be valid for their findings to be accurate:

1. That the specified impulsive information recorded on Channel 1 of the DPD radio system during the assassination of President Kennedy on November 22, 1963, must have originated in or very near Dealey Plaza, Dallas, Texas.* If this premise is not true, then the information analyzed could not have been generated within Dealey Plaza, and thus the findings of BBN, Weiss and Aschkenasy concerning the gunshots fired during the Presidential assassination would be invalid.

2. That the four specified impulsive patterns identified by BBN on the DPD recording are gunshot blasts, and are not other sounds or electrical impulses produced internally by the DPD radio system. The third designated impulse pattern was the only one utilized by Weiss and Aschkenasy in their analysis. If this premise is not true, then the information analyzed did not represent gunshots, and thus the findings of BBN, Weiss and Aschkenasy concerning the possible gunshots fired during the Presidential assassination would be invalid.

There are at least two known acoustical and one non-acoustical method that could determine whether the four specified impulsive patterns on the DPD recording originated from Dealey Plaza, Dallas, Texas, during the Presidential assassination on November 22, 1963. If it can be shown acoustically that the other information on the DPD recording just before, during, and just after the pertinent time period was exclusively from Dealey Plaza, then there is a very high probability that the four impulsive patterns also represent sounds produced in Dealey Plaza. It can also be acoustically proven that the patterns represent sounds from Dealey Plaza if the information being analyzed is unique to Dealey Plaza, to the exclusion of all other locations within the range of the DPD radio system. The non-acoustical method requires proof from eyewitness testimony.

*That is, the impulsive sound must have been loud enough to have been received within Dealey Plaza.

The first acoustical method cannot be used to validate that the designated impulsive information originated in Dealey Plaza, since other sounds during the pertinent portion either did not originate from Dealey Plaza or their origin is unknown. The two reports to the Committee reflect that a carillon bell is heard approximately seven seconds after the last gunshot and no known carillon bells have been located in the vicinity of Dealey Plaza; that "...there are brief voice signals from other remote transmitters. Sometimes these signals are too faint to be understood,... sometimes they are loud but very distorted, and sometimes they are quite intelligible. These competing transmissions are often, but not always, accompanied by heterodynes, which are tones caused by slight differences in frequency among the competing transmitters;" and that no sounds are heard on the recording that would reflect that the specific information originated in Dealey Plaza, such as crowds cheering, recognizable voices, etc. Clearly this method does not show that the designated patterns originated from Dealey Plaza, and in fact, reflects contrary information.

The second acoustical method utilizing the alleged uniqueness of the designated sounds as applied by Weiss and Aschkenasy, also cannot validate that the impulsive information is from Dealey Plaza. Weiss and Aschkenasy stated that "If we now assume that the sound source (the gun) and the listener are located in a typical urban environment, with a number of randomly spaced echo-producing structures, it is possible to see that the pattern of sounds a listener will hear will be complex and unique for any given pair of gun and listener locations." Other than explaining this statement in more detail, they do not provide any empirical or theoretical data to prove this uniqueness.

By locating the sound source in the general vicinity of the grassy knoll and the listener in the approximate location of the motorcycles in the Presidential motorcade, Weiss and Aschkenasy then computed the expected delay times for different echo paths using string on the topographical survey map of Dealey Plaza. The echo delay times occur because it takes a longer period of time for a sound to travel from the sound source to a reflecting surface and to the listener, than to go directly from the sound source to the listener. By shifting the sound source and listener locations slightly, they computed the best match with the impulsive pattern on the DPD recording by maximizing the binary correlation coefficient, a statistical analysis which equals 1.0 when two sequences match perfectly. In one correlation of the first 50 milliseconds, Weiss and Aschkenasy compared the impulsive pattern of 18 impulse peaks on the DPD recording, each with a very wide plus or minus 1 millisecond window, to the 12 computed echo delay times, and found 11 matching peaks which, according to them, results in a probability of 95% or better that the impulsive pattern on the DPD recording matches the predicted echo pattern in Dealey Plaza. In other words, the predicted sequence for a gunshot fired on the grassy knoll in Dealey Plaza and received by a microphone on a DPD motorcycle, also in Dealey Plaza, matches the designated impulsive sequence on the DPD recording with a probability of 95% or better. It is noted that the 18 impulse peaks, each with a plus or minus one millisecond-wide window, would result in approximately 36 milliseconds of the 50-millisecond time period being covered by the windows of the DPD impulses, since Weiss and Aschkenasy considered impulse peaks less than 1 millisecond apart to be part of the same peak.

In November, 1979, a violent confrontation occurred between members of the Ku Klux Klan, the Nazi Party, and the Communist Workers Party in a residential area of Greensboro, N. C., in which five people were killed (the FBI investigation in this matter is being handled under the caption "GREENKIL"). Using professional equipment, local TV personnel on the scene filmed and video taped the events as they happened, including known gunshots and other impulsive sounds that were not gunshots. One of the known gunshots in GREENKIL was compared by FBI acoustical experts to the alleged third shot on the DPD recording, using the same correlation method advocated by BBN, Weiss and Aschkenasy. A probability of 95% or better was found that this gunshot in Greensboro, N. C., in November, 1979, also represents the same impulsive pattern found on the DPD recording during the Presidential assassination in November, 1963.

If Weiss and Aschkenasy had used slightly smaller windows of plus or minus 0.9 millisecond instead of 1.0 millisecond windows, their binary correlation coefficient would have dropped to 0.54, or a probability of only 44% that the sound pattern on the DPD recording would match the predicted echo sequence from the grassy knoll; whereas the plus or minus 0.9 millisecond windows would have resulted in the same 95% or better probability for the gunshot in the Greensboro, N. C. matching the impulsive pattern on the DPD recording. In other words, using the 0.9 millisecond windows and the binary correlation method advocated by BBN, Weiss, and Aschkenasy, the gunshot in 1979 in Greensboro, N. C. had a much higher probability of matching the designated pattern recorded on the DPD recording than the predicted echo pattern of a gunshot from the grassy knoll in Dealey Plaza.

Aschkenasy stated in his oral testimony that if another sound pattern was found that matched the designated pattern on the DPD recording, he "...would expect to find...a replica of Dealey Plaza at that location. That's the only way that it can come out." However, Dealey Plaza is an urban area with small parks, tall buildings and a number of intersecting wide streets; whereas, the residential area in Greensboro, N. C. has two narrow streets meeting in a "T" intersection, one- and two-story buildings, and small residential lots with fences. The residential area in Greensboro, N. C. is definitely not a replica of Dealey Plaza.

The analysis in the GREENKIL investigation clearly disproves the uniqueness assumption, as applied by BBN, Weiss and Aschkenasy, to show that the impulsive patterns originated in Dealey Plaza. The unplanned occurrence of a gunshot in a residential section of Greensboro, N. C. 16 years after the Kennedy assassination produces an excellent match, using the binary correlation method employed by BBN, Weiss and Aschkenasy, with the designated pattern on the DPD recording that is allegedly the gunshot from the grassy knoll. It is probable then to expect that many of the urban areas within range of the DPD recording system could produce numerous sets of sound sources and microphone locations that would have a very high correlation when compared with the patterns on the DPD recording.

A third, nonacoustical method to determine that the information came from Dealey Plaza is by eyewitnesses who can testify that a DPD motorcycle microphone was "stuck open" in Dealey Plaza on channel 1 and that the information from this particular microphone was being received and exclusively recorded at DPD Headquarters. No conclusive testimony to support this eyewitness method was presented to the Committee.

Therefore, BBN, Weiss and Aschkenasy did not prove that the information on the DPD recording during the Presidential assassination on November 22, 1963, originated in or very near Dealey Plaza, Dallas, Texas.

To prove that a particular sound is a gunshot blast, some unique characteristics must be found that differentiates a gunshot blast from other sounds, especially ones that are impulsive. Weiss and Aschkenasy stated in their written report that "the most effective and most reliable" characteristic to determine if a sound is a gunshot and not some other like sound "is the sequence of delay times of the muzzle-blast echoes." However, in contradiction of their written report, Weiss in oral testimony before the Committee on December 29, 1978, stated that "...not so much the echo pattern as the evidence of a [supersonic] shock wave..." would differentiate a gunshot from other impulsive sounds. Again contradicting themselves, Weiss and Aschkenasy stated in their written report that they made no serious examination to determine if there was a shock wave present before the designated third pattern on the DPD recording. It is not possible to determine from the above which method, if any, Weiss and Aschkenasy used to determine if an impulsive pattern represents a gunshot blast.

If Weiss and Aschkenasy used "...the sequence of delay times" as "the most effective and most reliable" characteristic to determine if an impulsive sound is a gunshot, then their theory fails. Figure 1 shows a known gunshot pattern and figures 2 and 3 show patterns from other impulsive-type sounds in the GREENKIL investigation, all with a set of delay echoes; therefore this empirical data reflects that other impulsive sounds also produce echoes off buildings, vehicles, etc. Scientific literature also reflects that all sounds, especially impulsive, produce diffractions and reflections or echoes off hard surfaces.

If Weiss and Aschkenasy used the presence of a "shock wave" as the best characteristic to determine if an impulsive sound is a gunshot, then their theory again fails. Analysis in the GREENKIL examination determined that to detect a shock wave accurately is very difficult, even under high quality forensic conditions, since the shock wave itself produces a set of delay echoes which combine and change many of the characteristics of the muzzle blast sound signal. Under the poor conditions encountered on the DPD recording, making any statements concerning the shock wave would be extremely questionable. This may be why Weiss and Aschkenasy decided not to comment on the possible presence of a shock wave in their written report. Dr. Barger, in his oral testimony before the Committee on December 29, 1978, stated that there is a 75% to 80% chance that a shock wave exists before the distorted waveform examined by Weiss and Aschkenasy on the DPD recording. Again the distorted waveform examined on the DPD recording cannot support even this lower percentage estimate.

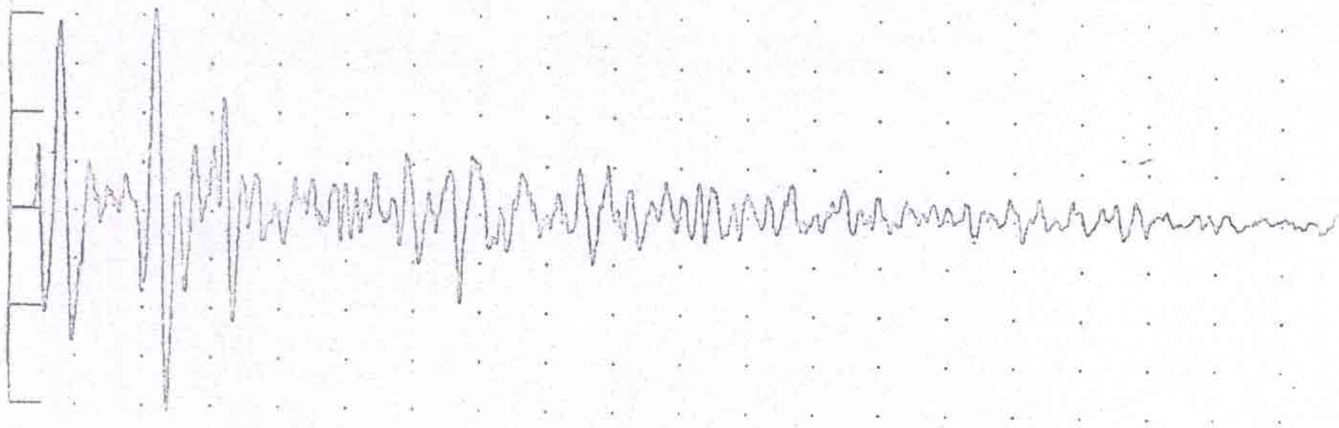

Figure 1. Waveform of a gunshot blast in GREENKIL.

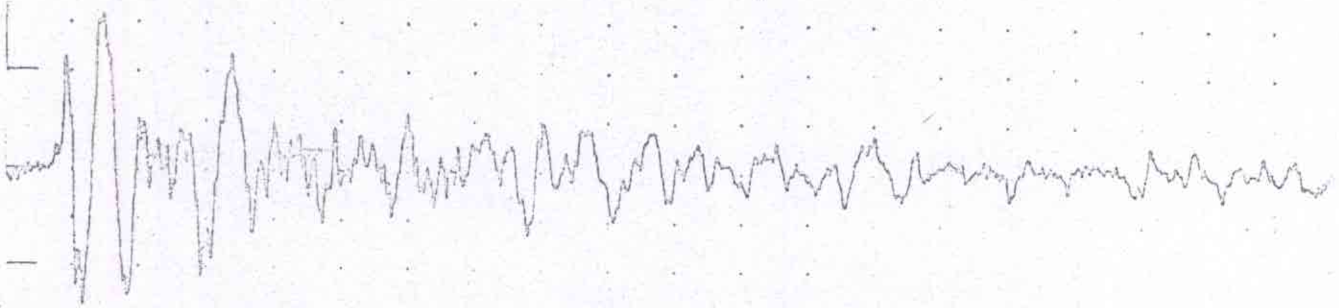

Figure 2. Waveform of a stick hitting an object in GREENKIL.

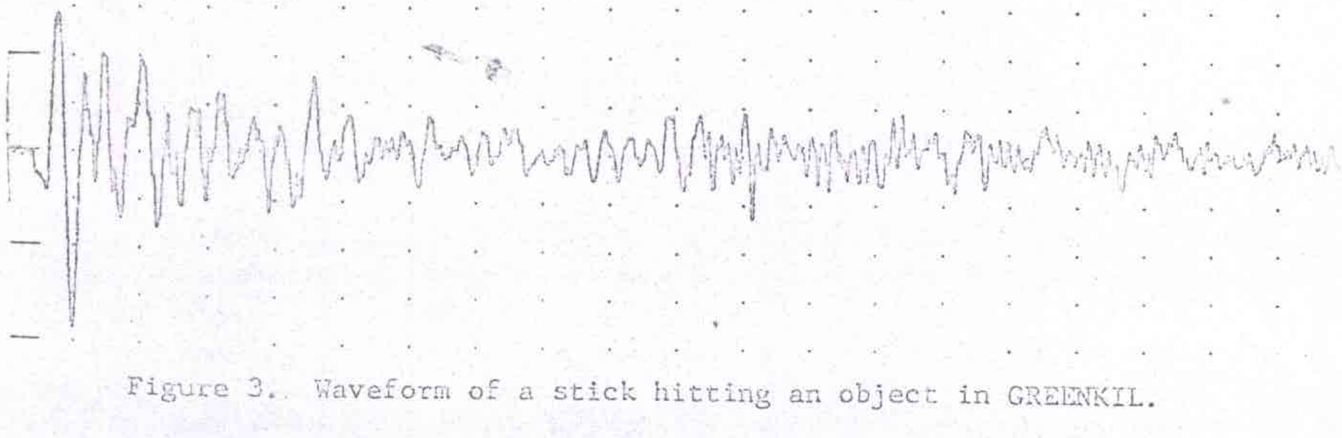

Figure 3. Waveform of a stick hitting an object in GREENKIL.

There is no proof provided by BBN, Weiss and Aschkenasy that the four patterns on the DPD recording represent gunshot blasts and not some other sounds or electrical impulses produced internally by the DPD radio system.

Since both necessary premises were not proven by BBN, Weiss and Aschkenasy, then their findings must be considered invalid. They neither proved that the impulses on the DPD recording were generated within Dealey Plaza nor that they were the sounds of gunshots. Therefore, the Committee's finding that "scientific acoustical evidence establishes a high probability that two gunmen fired at President John F. Kennedy" is also invalid.

Numerous other problem areas and inconsistencies were noted in the reports of BBN and Weiss and Aschkenasy, including the following:

1. Weiss and Aschkenasy stated on page 14 of their written report that "Impulse peaks that are less than 1 millisecond apart are considered to be part of the same impulse." However, in Table 4 on page 27 of their report they listed separate impulses at 19.3 and 20.1 milliseconds, which are only 0.8 milliseconds apart.

2. Figure 10 on page 76 of the BBN report reflects the considerable convolutional change that occurs to the sound of a gunshot blast transmitted and recorded by a police radio system similar to the one used by the DPD in 1963. This considerable change in the sound pattern is such that accurate analysis of any impulsive sounds produced by this system would be very difficult.

3. No known microscopic examination of the original DPD Dictabelt has been conducted to determine if any of the patterns analyzed may have been caused by surface imperfections on the Dictabelt and then distorted by the equipment's poor amplification system.

4. BBN eliminated a number of possibly useful impulsive patterns because they presupposed that gunshots originating on the grassy knoll and in the TSBD were aimed at President Kennedy and that these gunshot sounds were transmitted by a DPD motorcycle microphone located in the Presidential motorcade. One pattern was not further analyzed because it would represent a gunshot "...fired in a direction opposite to that of the logical target." Another pattern was eliminated "...because it occurred only 1.05 sec later than earlier correlations also obtained from the TSBD. The rifle cannot be fired that rapidly." BBN did not consider whether a second gunman could have been at the same location. Four impulsive patterns were eliminated because the specified motorcycle would probably be traveling too fast to be in the motorcade; however, the impulse could have been received by another motorcycle with an open microphone or in another part of the city. In other words, six other gunshots may have occurred in Dealey Plaza, according to the BBN analysis, though not necessarily aimed at President Kennedy or received by the specified motorcycle.

5. Weiss and Aschkenasy, after determining that the error range for temperature and recorder speed variations was minus 3.0% to minus 7.0%, stated that a minus 4.3% correction "gave the best match, and we therefore, used that factor." Rigorous scientific research would not allow adjusting the error factor to make the best fit with the presupposed positions of a sound source and a listener.

V. REPLY TO DEPARTMENT OF JUSTICE REQUESTS OF NOVEMBER 8, 1979

By letter dated November 8, 1979, from Robert L. Keuch, Special Counsel to the Attorney General, to the Director, FBI, and captioned "Report of the Select Committee on Assassinations," the following requests were made of the FBI's Technical Services Division.

1. Provide any information concerning the theory and application of acoustical principles as they relate to the analysis of the DPD tape.

2. Advise whether further scientific tests and analyses should be conducted of the DPD recording. If further analyses are recommended, advise who should conduct the examinations.

21

3. Provide any additional recommendations that are pertinent to the acoustical examinations.

Sections II, III, and IV of this review set forth a summary of the acoustical reports of BBN and Weiss and Aschkenasy, and a critique of their reports. The critique reflects that these acoustical reports failed to scientifically prove the location or even the existence of any gunshots on the DPD recording made during the assassination of President Kennedy. The critique also lists a number of other major faults in the acoustical reports of BBN and Weiss and Aschkenasy; however, to list and document all of the numerous errors found would require a considerable amount of time beyond that presently available to Technical Services Division personnel.

Visual examination of the waveforms displayed in the acoustical reports reflect that they are of very poor quality, probably due to the limited quality of the transmitting, receiving, and recording facilities of the DPD radio system. Due to this poor quality, it is considered highly unlikely that any valid scientific conclusions would be reached as to the exact nature of the designated impulsive patterns recorded on the DPD Dictabelt or their sources.

If the Department of Justice (DOJ) decides that a thorough examination should be conducted of the DPD recording, even with the high probability that no valid conclusions could be reached, then the choices are very restricted. The organization or independent consultant conducting such an examination must have considerable knowledge and the appropriate experience in the fields of forensic acoustics, especially as it relates to gunshot blasts; forensic signal analysis; tape recorder and microphone theory; radio communications, RF propagation, receivers and antennas; forensic firearms and ballistics; digital signal processing; and statistical analysis. The organization or consultant would also need a high speed digital processing system, a complete forensic acoustics laboratory, a firearms test range, and appropriate radio equipment, tape recorders, microphones, and digital waveform analysis equipment.

The FBI's Signal Analysis Unit, in the Engineering Section of the Technical Services Division has been involved on a full-time basis in the fields of forensic acoustics, signal analysis, ballistics, and engineering for a number of years. FBI acoustical experts have examined and analyzed a number of recordings containing gunshots and other impulsive-type sounds. In the GREENKIL investigation, the FBI acoustically examined over 100 impulsive-type sounds that had been recorded on site in Greensboro, N. C., with professional recording equipment. The examination determined that 39 gunshots had been fired and specified the location of each gunshot fired by members of the Ku Klux Klan, the Nazi Party, and Communist Workers Party. This examination took approximately one and one half man-years and the results were presented in criminal court in Greensboro, N. C., in September, 1980, by an FBI acoustical expert. The FBI has the necessary expertise, but a full scale examination of the acoustic evidence, including additional tests, if needed, in Dealey Plaza, would be a tremendous undertaking, especially considering the probable inconclusive results. It would take at least two to three years, require 10 - 12 man-years of work, cost in excess of $1,000,000 for travel and specialized equipment and require a number of new personnel to be assigned to the Signal Analysis Unit of the Engineering Section to replace the experts that would be involved on the project.

Due to the very limited quality of the DPD Dictabelt recording, and the remote possibility that further scientific research would produce valid results, no additional recommendations are being made at this time.